IMPORTANT - Membership
Renewal Form enclosed on pg.31

AMSAT™ NEWSLETTER

Publications
Contest
Winner
1977,1978

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Please address all correspondence to AMSAT, P. O. Box 27, Washington, D.C., 20044, U.S.A. Telephone: (202) 488-8649.

Editor: Joe Kasser, G3ZCZ , 11532 Stewart Lane, Silver Spring, MD, 20904, U.S.A. Telephone: (301) 622-2194.

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MEMBER

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Amateur Radio News Service

Copy Deadline for next issue is 1 November 1979

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COVER PICTURE

Mode J Antenna System at K9CIS Showing AZ-EL Mounting, Counterweight and Placement of BP Filter and 70 cm Pre-amp. (Figure 3 of K9CIS' article.)

CONTENTS

STOP PRESS

Owing to the pressure of business commitments, Vic, W1NU has resigned as AMSAT Bulletin Station Co-ordinator and as Phase III General Bulletin Channel Co-ordinator.

Ed Lipps, W3BWU has accepted the appointment as AMSAT Bulletin Station co-ordinator, and Pat, G3IOR, takes up the position of Phase III General Bulletin Channel Co-ordinator.

W3BWU and G3IOR can be contacted QTHR

* *

EDITORIAL

The Tools for the Job

Users' attitudes to Mode J range from terrible to fantastic. There are some who swear by that mode and some who swear at it. Why? Those who swear by it are usually equipped with sensitive low noise receiving systems. Those who swear at it are not. How many people would consider working twenty meters using a crystal set receiver? If they did, what kind of results would they get? When any job or activity is performed, having the correct tools for that task makes its performance more efficient and a lot more enjoyable. This issue of the Newsletter contains an article about receiving systems for Mode J. If you have difficulty hearing the satellite, consider some improvements to your station receiver.

Annual Elections

As announced last issue, the elections are coming up. Our organization has some tough decisions to make about its future (see Tom Clark's article in these pages). If you don't vote for the candidates of your choice, don't complain later. If you don't know anything about the candidates other than that information given last time, get on the nets and ask. The next board of directors is going to be a crucial one. Make sure that the interests of the members (your interests) are reflected in the composition of the board.

Computer Project

The computer project continues. The AR-1 RTTY card is again delayed. I'm not sure when that will see the light of day. One prototype has been built and tested, and some modifications have to be done to the artwork. When will they be finished, only the volunteer doing them knows.

Phase III and Computer Related Printed Circuits

Arrangements are being made to make them generally available. If you are interested, send as sase to me at the editorial address on page 2 or wait for the December Newsletter.

Response to the Previous Editorial

A number of letters have come in concerning your feelings about the Newsletter. To those who have written, thank you. For your information, currently the vast majority of writers are in favour of major changes and expansion of the Newsletter.

Membership Renewal

It is renewal time. This year we are trying something new. Our standard membership application form requests that you list certain skills and asks if the applicant is willing to help AMSAT. Until now we have had no practical way of retrieving that information. We are currently putting our membership list on a computer (Northstar format) and thus will have a way of matching skills to tasks. Thus, if you are a life member and are willing to accept an assignment from AMSAT, take a moment to complete the form on page 31 and mail it in.

Joe

Joe, G3ZCZ

A NEW AMSAT FOR THE EIGHTIES???

By Tom Clark, W3IWI
AMSAT Executive Vice-President

No, this isn't an advertisement for a new compact car from Detroit; rather it is an introduction to the topic of a special forum to be held on the afternoon of Saturday, October 6, 1979 in conjunction with AMSAT's annual meeting. But before introducing this topic, let me give you the agenda for the entire day's festivities (all times local):

10:00 - 13:30	A tour of the AMSAT-OSCAR Spacecraft Laboratory to see the first Phase III satellite undergoing final integration. You may also want to visit NASA/Goddard's interesting Visitor's Center Museum, some of the control rooms at Goddard and the facilities at WA3NAN.
14:00 - 17:30	Forum - A NEW AMSAT FOR THE EIGHTIES?? (Organized by Vern Riportella, WA2LQQ)
17:30 - 18:30	Attitude adjustment and eyeball QSO hour. Refreshments will be provided.
18:30 - 20:00	Steak dinner (price to be announced, but quite reasonable - ask anyone who has been at the recent Annual Meetings!). Please let us know, either via the NETS or by writing Box 27, Washington, DC, 20044 if you will be at the dinner --- We need to know how much food to have on hand. You will pay at the door.
20:00 - 23:00	AMSAT Annual Meetings and election of new members of the Board of Directors.

The forum, social hour, dinner and meeting will all be held at the Goddard Employees Recreation Center and are co-sponsored by the Goddard Amateur Radio Club (alias WA3NAN). The AMSAT Lab and the Visitor's Center are within 1 km of the Recreation Center.

And now to the topic of the afternoon forum. AMSAT was founded just 10 years ago and in the intervening period, its technical accomplishments -- OSCAR's 5, 6, 7 and 8 and now Phase III -- have been spectacular. The founders of AMSAT were a "hardcore" of technically-minded individuals, without whose foresight none of these projects could have happened. As time went on, additional technical talent appeared on the horizon and AMSAT "went international". With technical success came an expanded user base -- now totaling some 4500 members -- who all showed a keen interest in what was happening. But the central management of the organization was still in the hands of the technical types. For some time we have perceived that AMSAT is now getting too big for the old structure; the current size is WRONG -- too big to be a collection of technocratic prima donnas, and yet too small to provide all the services that the membership seems to be demanding. We receive many criticisms "Why didn't you answer my letter?", "What happened to my newsletter?", "When will you make a firm pronouncement on....", etc. The underlying thread through all these is "YOU should do .... for ME". We need to look towards the era of Phase III, the 1980's, as a challenge to set up the kind of organization that YOU feel is needed. To this end, I have asked Vern Riportella, WA2LQQ to use his systems analyst's talents to study the organization and see where it should be going. Rip has a distinct advantage in that he has not been one of the "inner circle" who may have developed a bad case of myopia over the years. Rip, along with a few other clever individuals of his choosing, is serving as an ad hoc Plans and Programs committee. I would now like to have you pay heed to his words extracted from a letter to one of the individuals he was recruiting to help in these tasks:

> "...It was a distinct pleasure to chat with you this afternoon and I certainly enjoyed the exchange of views.
>
> "As you might have gathered from the discourse, I tend to think of things in terms of systems; little systems embedded in big systems. Thus I tend to view the apparent perturbations in AMSAT as evidence of a systematic error of some sort. What I have been trying to do in the past few months is to circumscribe the system and to then isolate and analyze the components. What I perceive so far is neither all bad nor all good. In fact, the more I appreciate the manner in which the organization has evolved, the more natural becomes the result I perceive. What requires very little scrutiny to perceive, though, is that a need

for the creation of certain Management mechanisms and the polishing of others exists.

"And that's where we perhaps can make a few positive contributions. I see our objectives to be basically of two kinds: (A) Direct intervention by producing those documents and mechanisms without which an organization of AMSAT's size is sorely pressed to function efficiently and (B) Indirect action by specifying those administrative actions most likely to produce a broader range of participation by the membership at large. This second facet in turn embodies, it would seem, a multiphase effort itself. 1. Identification 2. Calibration 3. Training 4. Tasking 5. Perpetuating and improving the recruitment system.

"As you recognize, whenever the word "change" is mentioned, there usually is a bit of inertia to be overcome. The directors and officers of AMSAT are not totally immune to this syndrome. However, as a lot, they are a rather progressive group, although I suspect that their basic engineering/scientific orientation promotes some conservatism. Had they not been progressive, they would not have gone into amateur satellite building, but would instead have been content with some more mundane avocation/profession.

"The image that emerges is one of a covey of clever chaps who are overwhelmed by the magnitude of the tasks they have undertaken, not so much that they are in themselves individually unmanageable, but, to paraphrase the most frequently heard complaint, "There's too ..... much to do and too few hands and heads to do it!" Perhaps the word overwhelmed is a bit too strong, for the flavor I wish to connote is more like quiet dismay, mixed with a bit of not so quiet frustration over the enormity and scope of the work to be done.

"Then too are the external pressures which affect the troops. Trying to service the demands of members who range from the sincerely concerned individual here to the lunatic fringe there is less than a rewarding enterprise for those who have all their creative energies (and then some!) consumed with their prime task: getting the first Phase III ready for its March, 1980 launch. Have you read some of the letters which appear in the AMSAT Newsletter? e.g. "You guys are a bunch of bums. Why, if you don't turn the bird on on Wednesdays, I'm not going to use the satellite anymore!" What rubbish. And yet there is an obligation to respond, most of the time, to this kind of balderdash.

"Other pressures include the adventures (or mis-adventures?) in the areas of foreign relations. They arise because AMSAT is a multinational endeavor. About a third of the membership is outside the US. Major hardware activities are underway in the AMSAT-Canada, AMSAT-DL, AMSAT-UK, JAMSAT, Hungarian and AMSAT-I groups. The first Phase III will be launched on a European launch vehicle from FY7. Attitudes and lifestyles (not to mention postal rates, customs, duties, etc.) vary markedly from country to country. All this requires, as you might surmise, the most delicate of diplomatic touches; not an arena in which your average engineer/scientist is, a priori, particularly well trained.

"My point here is not to defend this crew. They are amply equipped to do that themselves (and will at the slightest provocation!). Rather, I want to point out some of the complicating issues which mitigate my indictment of the way things are run within the organization.

"To pick up a string I dropped a few paragraphs ago, regarding change...: The current leadership seems willing to accept change but I'm afraid that, because they're already up to their collective ears, they are going to have to be spoon-fed for a while..at least until they have their heads above water. By this I mean that if meaningful change is to be effected, the work must be done by chaps like you and me. And if it can be shown clearly that any proposed change(s) will add more to efficiency than it adds to burden, I can see no great reluctance to adapt or evolve. Evolve is a very important word here. Clearly, to attempt to grab the AMSAT Bull by the horns and try to wrestle it into some fine-tuned system we perceive as being more efficient and/or responsive could be a self-defeating endeavor. Therefore, the present system must be carefully massaged. A small tweak here, a new subsystem there, until the monster starts to behave like a well-trained animal (you should pardon the mixed metaphors).

I'll add a third metaphor for fun. Remember the one about the firemen who were too busy fighting fires to repair the fire engine?? The images this metaphor conveys are to me all that is needed to get the flavor of the current modus operandi.

"So, if meaningful change is in fact to be implemented, it must come in the form of neat, well-defined and well-organized packages. They must be easy to understand so that the investment in changing the system doesn't outweigh the benefits. And they must be modular so that they can be implemented in a methodical manner. All the time we must be wary of ripples. Not that ripples in the pond are inherently to be feared, since one gets valuable feedback by observing the ripples. But if too many stones are dropped at once, it will be nigh unto impossible to discriminate the effective rocks from the clods! And that may result in a poorer system operation than that with which you began.

"That brings about the point that I have heard many times over in the past months. I've tried to keep my ear to the ground to pick up the "vibes" of the organization. The theme I keep hearing is communication, communication, communication. What's going on at AMSAT HQ??? It would be particularly ironic if the constructors of one of the Amateur Community's most advanced communication systems should be suffering from a communications gap! But the "vibes" I am getting indicate exactly this to be the case. Not that there are any secrets to be hidden and anyone who would take the time could learn much by talking with some of the HQ gang when they show up at conventions. Or for that matter by writing to HQ as some did (and depending on the nature of your letter and who received it, perhaps having it disappear into an abyss!). Unfortunately, in the present circumstances, responding to membership inquiries must take second priority to getting Ø3A built. So let me turn on this point to some things I think we can do to alleviate a most difficult situation.

"First, I think we have made the first steps already in trying to understand the mechanism as it now exists. A clearer picture emerges when you integrate that understanding with a theory of how the group evolved over its first decade of existence.

"Next, I believe we should examine the organizational structure in terms of functions and throughput. In general this is the"goesintas" and the "comesouttas". I've tried to sketch the overall organizational chart but it is a mess. It seems that the functions are a rather tangled cross between a line organization and a matrix organization. Line and staff relations are anything but clearly defined. In fact I'm not sure that "A" doesn't work for "B" who is in turn responsible to "A". Nevertheless, it is a start. A better start might be to try to write a description of each of the functions performed at present. The problem here is that everybody does everything as required by the workload...almost. Then we can examine management structures which might perform the same overall functions, and then attempt to meld the two so that there might be an orderly transition. Parallel with this should be the identification of all the functions that need to be performed. Finally, considering that the key resource is people, we ask which functions should the present crew perform, and where are new people required? How do you implement this complex structure with volunteers plus a paid nuclear staff? The answer is the recruitment program I mentioned earlier. We need to get some clever new people to come out of the woodwork. But who is to do the recruiting? Up pops the need for a function called resource management. Throughout all these efforts, we must in fact deal with real people, with real egos, and with a real-world rate of expansion of the organization. The present activities need to continue through any attempted reorganization.

"So although it is amusing to deal with the grand strategy and although a view to the global aspects of the system are in order we are constrained to consider changes in terms of modules. Moreover, we must recognize the complex symbiosis extant between the 'builders' and 'users'. Without the satellite hardware/software, the command stations, the orbit books, newsletters, etc., the 'user' population would evaporate and with it AMSAT. On the other hand, without the active support of the 'users', the 'builders' could not function. So the inherent synergy of the two groups must be promoted through improved rapport. This would then seem a fertile area for module design.

"As mentioned above, we are here dealing with a dynamic system. It would be trivial by comparison to say, in effect, 'stop the works so we can overhaul the beasty.' But then what would we have? A dead beast or at least one in suspended animation, and that is not a prospect to warm the cockles of your heart. Obviously if we are to understand the machinations and dynamics we must catch the beast mid-stride in a series of 'snapshots'. Complicating the 'snapshot' technique though, is the growth in member/user population anticipated to attend Ø3A. Although the leadership composition has remained relatively stable for some years, the user

population and commensurate support level required has increased dramatically. With the advent of the Phase III series, projections indicate at least an order-of-magnitude increase in the member/user base. How shall the present leadership cope with the new demands placed on its limited resources? It's my observation that the nucleus of AMSAT is composed of your basic "rugged individualist" type with the characteristic ego-drive so typical of over-achievers. (were they otherwise or less goal-oriented, they likely never would have undertaken such an ambitious program.) Consequently, the nuclear group universally seems frustrated with those who, through ignorance or neglect (or both), virtually demand to be spoon-fed. I use 'ignorance' here in the most literal, benign sense, for those who wish to learn surely need to be accomodated. Ignorance is merely the lack of knowledge and part of AMSAT's charter is based firmly in education. But should these requests for spoon-feeding be serviced at the expense of technical progress to the detriment of those who are well up on the learning curve, i.e., the experienced user?

"(A clear case of robbing Peter to pay Paul; a no-win situation when the fundamental premise of AMSAT is the existence of dedicated Amateur satellites built by the self-same individuals earnestly entreated to 'man the spoons'.) Clearly, here, as elsewhere, a balance needs be struck between the fundamental objectives of first providing the basic resource,i.e.,the satellite itself, and the legitimate requests of the novice for the provision of 'tools' with which to bootstrap himself into 'competent user' status! I hope that through our efforts in this area we can identify and help implement the requisite balance.

"It seems a curious artifact of our hobby that those who take positive action and as a result accrue some notoriety should be held in such awe by the community at large. Surely veneration is appropriate for some based on their singular contributions to the hobby. Some that 'bubble-up' at first approach are W1AW, W8JK, W1HDQ. Furthermore, although many AMSAT members apparently perceive the AMSAT nucleus with the awe justly due only to Superman, the members of the nuclear crew are, to the contrary and to a man, plainly mortal as evidenced by competent observation of their proclivity for being run over by administrative locomotives and their manifest aversion to bounding over tall bureaucratic buildings. As a test, next time you see one at a convention, open your container of Kryptonite; if he whithers, he's Superman, if he continues to answer your questions, he's mortal! Herein lies the key to enhancing member participation, I submit. Remove the aura of a few letters after their names and the dubious value of a WASHINGTON address and you'll find a pretty regular 'bunch of guys' in the nucleus. (By the way, I've bestowed an honorary degree on one of our Directors. He's now Dr. 'XY', ObD, Doctor of Obfuscation).

"To summarize to this point, there appear to be several fertile areas for modules to be designed. They are: communications mechanisms; user service requests; resource management; unfrocking or at least attenuating the aura which surrounds the alchemists at HQ; management feedback systems and a sound definition of what catalysts are needed for AMSAT's evolution in the 1980's. This evolution will, by any reasonable measure, be led by commencement of general operations on Ø3A. It would be well that we have the course charted by that time lest we find ourselves again (or still) with a broken fire engine! That is why I suggested one product you might work on would be a Phase III Operations Manual. As you put it rather succinctly, "who would think of running a business without a set of operating procedures?"

"I also mentioned to you that I have accepted a task to produce a white paper that would opine on the question, "What should AMSAT become in the 1980's?" This is a most intriguing question which virtually begs to be addressed. Though I've been thinking on it for barely a week, I suppose I could shoot from the hip and generate 20 or 30 pages on this subject in an evening. But I've restrained myself for the simple reason of the gravity of the issues. The optimum answer(s) depend on the issues relating to membership expectation, the attitudes of the "hardcore", the future of the AMSAT space program, the relationships with IARU/ARRL/RSGB/DARC/JARL, the results of WARC, etc. I would commend these questions to your attention for consideration. Perhaps we can combine our thoughts and opinions.

"I think I've rambled on quite long enough for openers. Hope to hear from you soon.

73,
Vern Riportella

Do you, the membership, care about these issues? Do you have some ideas? Join us at the afternoon forum and discuss your thoughts. Exercise your right to vote for the most qualified directors. Rip reports that some of the specific discussion items for the forum will include:

-- What can I, as a user, expect from Phase III? (To prime yourself for this discussion, review for example the June '79 AMSAT Newsletter, K2UBC's article on Pg. 32 of the August '77 issue of HAM RADIO, G3ZCZ's article in the November '78 issue of Byte Magazine and VE2BEN's article in the June '79 issue of HAM RADIO.)

-- How much growth can AMSAT expect when the Phase III satellites (both elliptical and synchronous) are operational? Can any AMSAT organizational structure tolerate such growth?

-- What kind of communications channels, both to and from the user community, are needed? What kind of information do the users really need?

-- How can we best handle the international nature of the Amateur Satellite program? Should we form a separate AMSAT-USA to interface with US users? (Like several other countries have done.)

-- How effective is the Newsletter? Do we need an expanded publication? Should the present Newsletter, AMSAT-UK's OSCAR News, the Mode-J Newsletter, etc. be merged into one larger, more frequent publication? Do we really need a separate orbit book?

-- How do we bring new "converts" into the fold, both as leaders and as users? Does the organization tend to intimidate newcomers? How does the average user/member perceive AMSAT?

-- And a whole host of other topics, too numerous to be mentioned.

So think about it. Try to be there in person for the Forum and Annual Meeting on October 6. But if you can't, send your ideas and thoughts to either/both of us:

Vern Riportella, WA2LQQ
AMSAT Plans/Prcgrams
RD #4 Bradner Drive
Warwick, NY 10990

Tom Clark, W3IWI
AMSAT Executive Vice President
6388 Guilford Rd
Clarksville, MD 21029

We need your continued support --- help get ready for the 80's!!!

AMSAT GRATEFULLY ACKNOWLEDGES DONATIONS OF $100 OR MORE FROM THE FOLLOWING NEW LIFE MEMBERS

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LM-1078 Joseph D. Moell, KØOV/WA6JFP
LM-1079 J.R. Dore, G3XPK
LM-1080 Osvaldo Briceno, YV6ASU
LM-1081 R.I. Buckby,, G3VGW
LM-1082 Bendoraitis, CP8AL
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LM-1106 Myles Graves, WB5RKE
LM-1107 Walter Scott, W3VTJ
LM-1108 Rainford Halls, WD4AWC
LM-1109 Roy Tabeling, W4IFW
LM-1110 Keith Conrad, WD8DYT
LM-1112 John Nuti, N9JE
LM-1113 Dr. John D. Chambers, WB7OPP
LM-1114 E. Adams, K2YEF

SATELLITE TRACKING

(IN REAL TIME WITH TRS-80 MICROCOMPUTER)

By Charles O. Webb, WB5UER

About three weeks before the fall of Skylab, I had an idea for tracking this particular spacecraft with my TRS-80 microcomputer. Since the model I am using is the TRS-80 level two with 16K of RAM, I wanted to save as much RAM as possible for tracking and not for graphics.

The program I used only uses "FOR/NEXT" loops for timing and puts a blinking light on the CRT for location of the (or any) spacecraft. With the use of the expansion interface, the timing will be more accurate and as the program is used with only FOR/NEXT loops one may have to experiment with different combinations for proper timing.

After visiting the Johnson Space Center in Houston and seeing the boards at Mission Control and operating the OSCAR station at that location, I decided that graphics could be simplified by using a plastic overlay for the TRS-80 video display.

First step was to obtain some clear plastic sheets which are available at most office supply dealers and with it several different colors of grease pencils. Next step was to copy a map of the world onto the plastic that would fit over the CRT for display. Using different colors of grease pencils, I marked all countries onto the plastic and also placed lines of latitude and longitude in red on the overlay. I left enough room at the bottom so that I could place the degrees bearing lines into the program vertically for each line of longitude.

Next, using the TRS-80 graphic sheet, I used carbon paper and traced out one orbit on the graphic paper. From this paper one can transfer direct to set locations on the CRT. For my use I located the spacecraft every three minutes and updated data for every three minutes.

The beginning of the program should have a reference line horizontally on the CRT for placement of the overlay and a line vertically for correct lineup of a particular line of longitude.

Once the overlay is completed it can be used for tracking any spacecraft in orbit (including the new Phase III) with minor changes in loops and locations. Numerous different satellites can be saved on tape and re-entered when needed.

With the use of the grease pencil, you can mark on the overlay the AOS, LOS, and any other data you desire such as times a certain station was worked and position of satellite. The marks can be wiped clean with a paper towel or cloth.

Program lines are simple and here are two that run consecutively:

```
120  X=85:Y=15:FORA=1T0126:SET(X,Y):FORAA=1T0300:NEXTAA:RESET(X,YY):
     FORN=1T0150:NEXTN:NEXTA

130  X=90:Y=14:FORA=1T0126:SET(X,Y):FORAA=1T0300:NEXTAA:RESET(X,Y)
     :FORN=1T0150:NEXTN:NEXTA
```

Once the program has been run for one orbit, the change to the new EQX can be achieved by simply changing the value of X and X only; this will update the program to the next orbit. More interesting data can be placed by the flashing light as to give azimuth and elevation bearings to satellite for antenna aiming as well as satellite speed, altitude and heading.

I am sending some pictures to show how overlay fits onto CRT with scotch tape and quality of finished product.

Happy tracking and OSCARING!

P.S. Am also experimenting with system for using Level Two for antenna control for tracking any spacecraft. Will advise when complete and send program and equipment needed for operation.

ECHO 70 CM SSB TRANSCEIVER IMPROVEMENTS FOR SATISFACTORY OSCAR RECEPTION

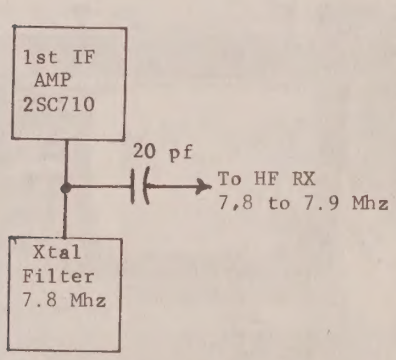
By Bob Clark, WØQIN

The primary problem with the Echo 70 Transceiver is receiving weak signals. This can be resolved by using a pre-amp and a HF receiver. The Echo 70 then becomes a converter for receiving and its performance is then far superior to the basic receiver.

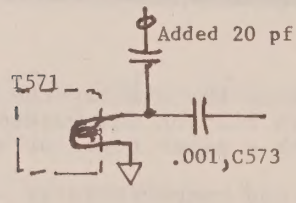
The circuits shown in Figure 1 indicate the required changes. Use the Owner's Guide manual to familiarize yourself with the modification and mark your schematic in red when changes are made!

The modification to the Echo 70 is as follows: (Use 1/8" coax)

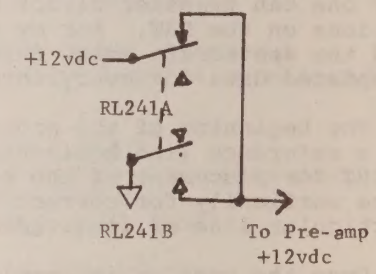
1. Remove cover.
2. Drill a ¼" hole at the rear of chassis next to the antenna connector, on switch side. (Be extremely careful that the bit does not grab and wipe out some parts!)
3. Disconnect the antenna lead at the relay RL941B. Splice a length of coax to this lead and connect another length of coax to the relay terminal. These leads will go to your pre-amp thru the ¼" hole. They should be approximately 12 inches long.
4. Connect a wire lead on the main circuit board to RL241B (12 vdc) for pre-amp. This pad is just to the right of board center and has an open hole for your +12 volt lead!



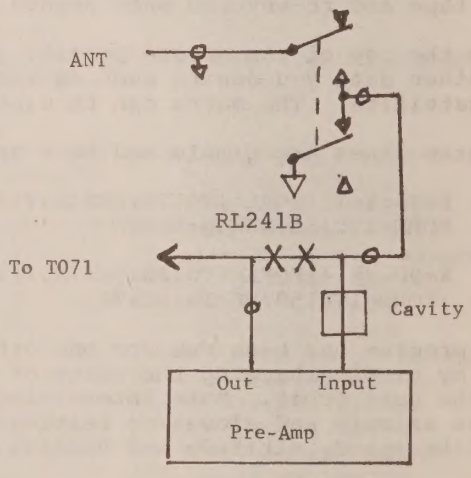
a) Block Diagram of HF RX connection



b) HF RX circuit



c) Pre-amp Power



d) Pre-Amp antenna connections

Figure 1

Circuit Modifcations

5. Solder a 20 pf capacitor where C573 (.001 mfd) capacitor connects to transformer T571.
6. The other end of the 20 pf goes to another length of coax. (To HF RX 2-4 feet) Dress the coax so the shield helps support the capacitor mechanically. Solder the shield to a convenient ground on the circuit board.
7. Dress the 12 volt lead and coax to rear of unit exiting thru the same hole as the pre-amp antenna leads.

This completes the modification and Figure 2 shows how it's tied together.

To setup for receiving, the coax lead going to the HF receiver is the 7.8 Mhz IF of the Echo 70. To utilize the signal for receive, the HF receiver has to cover 7.8 to 7.9 Mhz, the 100 Khz range for OSCAR signals. This will be inverted such that 7.9 Mhz corresponds to 432.1 and 7.8 Mhz to 432.2 Mhz. The Echo 70 is set to 21 and the band crystal to 432. With the system operating, tune the 7.8 Mhz local oscillator signal from the Echo 70 to 7.8 Mhz on the HF receiver by adjusting the VXO knob. This calibrates the HF receiver and you are ready to listen for OSCAR signals from 7.8 to 7.9 Mhz.

If you are going to use a HF transceiver be sure it's made 'idiot proof' so you don't 'zapp' the Echo 70 IF in case the transmitter is accidentally turned on. The Echo 70 can still function as a transceiver with no degradation even though the HF receiver cable is connected. If you want to use the HF receiver with the Echo 70 in transceive mode, the received signal will be at 7.8 Mhz with the LO signal. This can be tuned out with a notch filter or you might try using the Echo 70 RIT.

Regarding the pre-amp, there have been a few good articles on these so no problem there, but don't overlook a good cavity to keep the 'crud' out of the front end.

The above setup is being used with either a Drake SPR-4 or an Atlas 350 using crystals to allow coverage of the 7.5 to 8.0 Mhz range. Signals are easily copied on the HF receivers that cannot be heard on Mode J using the Echo 70 alone, and you have the great tuning and flexibility of the HF receiver.

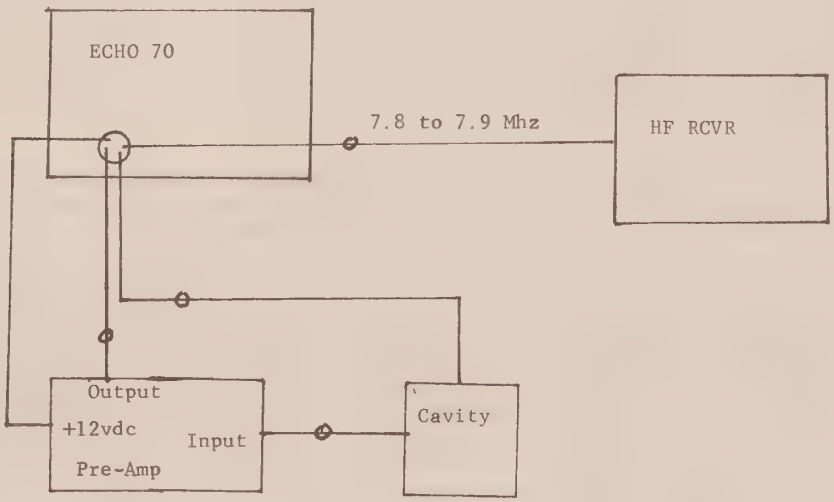


Figure 2

Echo 70 - HF Receiver setup

ORBIT DETERMINATION TECHNIQUES FOR RADIO AMATEURS

By Will J. Webster, Jr. WB2TNC

Since the days of Sputnik 1, radio amateurs have been active in orbit measurement for a wide variety of satellites. With the advent of the OSCAR and Radio-amateur Sputniki (RS) satellites, the techniques of orbit determination have become an even more important part of the amateur's technical arsenal.

In this paper, we review the two main techniques--a beacon doppler shift measurement and round-trip range timing--that have been used by amateurs. The operation of the measurement systems is discussed, examples of the data obtained are presented and the particular systems in use at WA3NAN are illustrated.

This discussion is constrained to low (2,500 km or less) orbit satellites. Specific problems of orbit determination for the Phase Three series OSCARS will be treated elsewhere.

INTRODUCTION

Orbit determination has been a part of amateur radio since the launching of Sputnik 1. History records that the USSR selected the 20 MHz telemetry frequency knowing that a large number of amateurs used the 20 MHz WWV signal for time and frequency calibration. Thus the first estimates of the orbit of Sputnik 1 were made by hams.

The need to continue this tradition was graphically illustrated by the launch of the two Radio Sputniki on October 25, 1978. Although some estimates of the orbital elements were available before the launch, it was necessary to change the estimates rather drastically to get a useable estimate of the orbit. Until definitive equator crossings, increments and periods were available for R-1 and R-2, the only orbital information available was the result of doppler tracking by amateurs.

In this paper, the doppler (range rate) and non-coherent range techniques are reviewed. These techniques, especially doppler tracking, have been used extensively for orbit determination with all of the amateur satellites to date. We will not discuss the somewhat more sophisticated techniques required for a highly elliptical orbit such as planned for the Phase III OSCARs but will restrict the discussion to nearly circular orbits with mean altitudes under 2,500 km. As an example of the kind of hardware required, the doppler and range systems used at WA3NAN for OSCAR-8 and RS will be described.

We will also describe the procedures by which orbital elements can be determined from observations. In particular, the procedures used to get the period and longitude increment from doppler data will be reviewed in detail.

DOPPLER TECHNIQUES

Up until about 1970, the principal orbit measurement technique used by professionals was the doppler technique. According to the doppler principle, a constant frequency oscillator will appear to rise and fall in frequency as it moves toward and away from a fixed observer. The amount of frequency change depends on the value of the component of velocity toward the observer. The doppler shift is smallest for passes near the horizon and largest for passes that cross through the zenith. This is illustrated in Figure 1. Figure 1 is a doppler curve observed on the 29.4 MHz beacon of RS-1 at W2SBI. The observations are compared with a curve calculated for a 35° maximum elevation pass of RS-1 using the formulas of Stahl (1958).

The features of the curve are: (a) the relatively constant apparent frequency at the beginning and end of the pass and (b) the occurrence of zero doppler shift at the mid-point of the pass. It can be shown (Stahl, 1958) that the time of zero doppler shift is the time of closest approach (TCA) of the satellite to the observer. Given a series of TCA measurements and a well determined station location, most of the needed orbital parameters can be determined. With TCAs, or more preferably complete curves, from a number of well located stations, there are several computer techniques that will allow a determination of all of the conventional orbital elements (McCuskey, 1963).

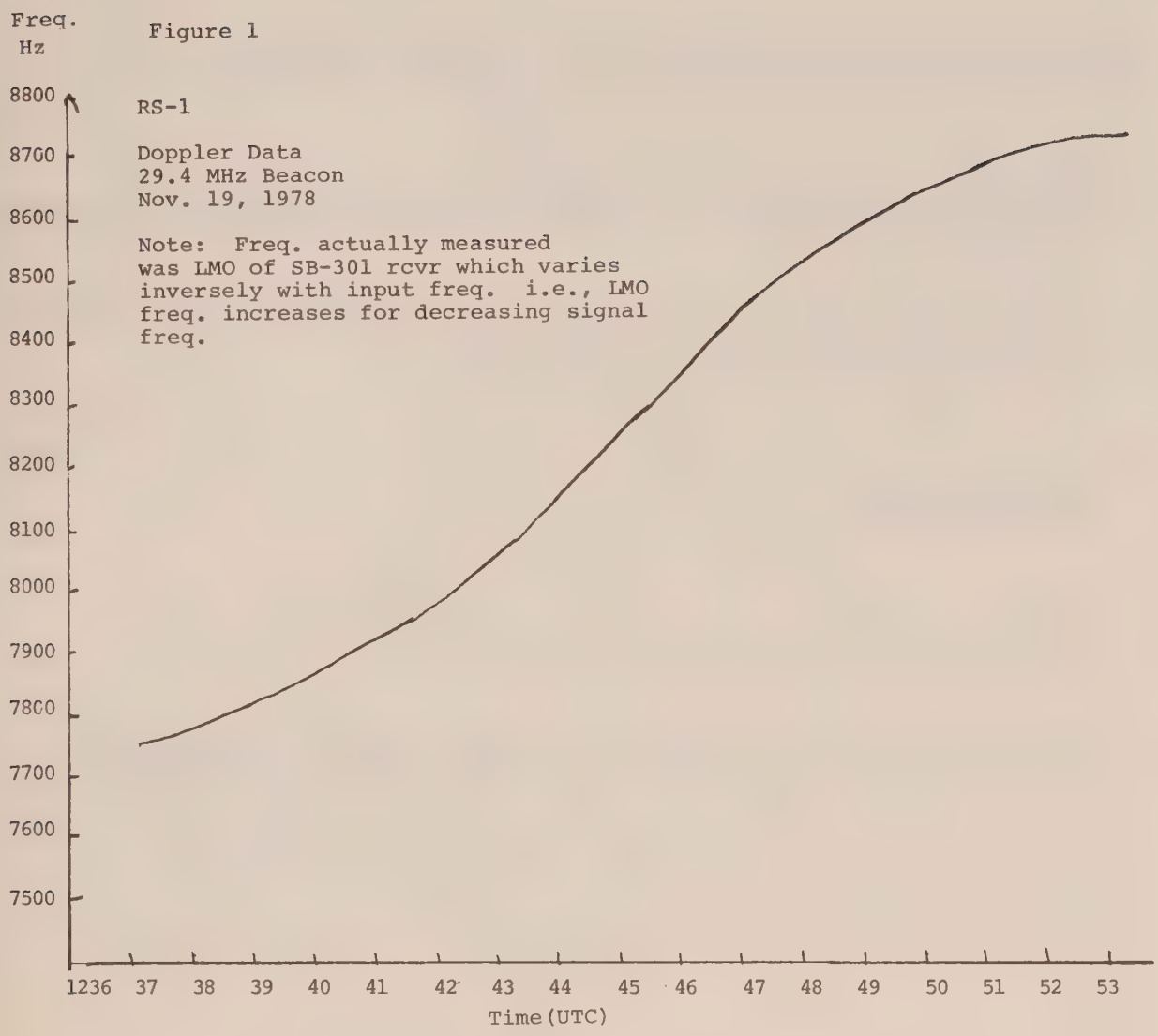


Figure 1

Analysis of the doppler curves for orbit determination can have several levels of complexity. For a full determination of the orbital elements, the usual procedure is to fit a theoretical doppler curve to each observed curve. This fitting is done by selecting the best from a set of curves calculated for small variations in orbital parameters and ionospheric conditions. In professional practice, this procedure can become quite sophisticated. The resulting errors in the orbital elements correspond to errors in the apparent distance to the satellite of around 3 km. The single most important factor, even in the 137 MHz band where most doppler work was done, is the ionosphere. Changes from site to site and from pass to pass at the same site are a major source of error. As a result, efficient and thorough modeling of the ionosphere has been the most important continuing problem in doppler tracking.

For many amateur purposes, it suffices to determine several different TCAs over as wide a range of orbit numbers as possible. From the TCAs, the nodal period can be determined. With a (not necessarily accurate) guess at the inclination, the increment can then be calculated. Figure 2 shows the logical flow of the determination process. Note that in the calculation of the increment, there are three terms which must be included.

Thus, given a guess at the period, inclination and one equator crossing, a series of TCAs is all that is needed to obtain a good estimate of the nodal period, nodal increment and reference equator crossing. Given a doppler curve, the determination of the TCA is a simple geometric exercise. In Figure 3, we show the analysis of a Doppler curve taken by W2SBI. This curve was taken on March 30, 1979 for the 29.4 MHz beacon of OSCAR-8. It can be shown that the time of maximum slope corresponds to the time of TCA. This time is easily determined by the construction of Figure 3.

Figure 2

ORBIT DETERMINATION FROM DOPPLER TCA MEASUREMENTS

(AFTER K2UBC)

1. ESTIMATE ORBITAL ELEMENTS, I.E., PERIOD, INCLINATION, REFERENCE ORBIT NODE AND LONGITUDE.

2. COLLECT DOPPLER DATA OVER A WIDE RANGE OF TIME TO OBTAIN AN IMPROVED PERIOD.

3. CALCULATE MEAN ORBITAL RADIUS FROM THE PERIOD.

$$T^2 = 4\pi^2 A^3/GM$$

4. CALCULATE INCREMENT

$$\text{INC}(^\circ/\text{ORBIT}) = 360^\circ/\text{DAY} + \frac{360^\circ \text{W/YR}}{365.25\ \text{DAY/YR}} + 9.95\left(\frac{\text{REQ}}{R}\right)^{3.5}\cos I$$

5. USE AOS AND LOS DATA TO ADJUST REFERENCE NODES TO BEST FIT OBSERVATIONS.

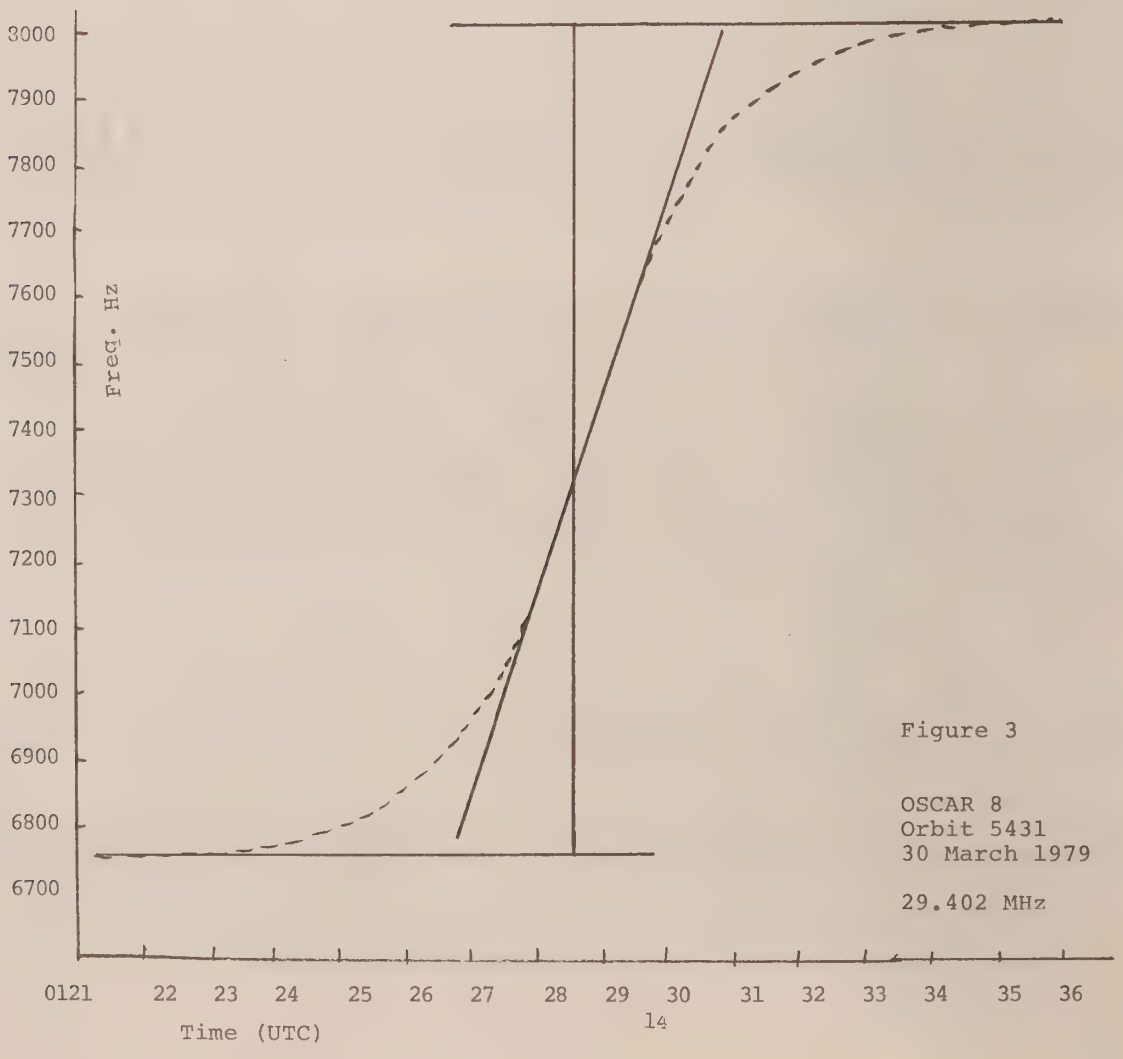


Figure 3

OSCAR 8
Orbit 5431
30 March 1979

29.402 MHz

Many different techniques are used by amateurs to make doppler measurements. Often, the type of receiver available is the dominant factor in setting up (viz. W2SBI). There are, however, a number of factors which must be considered in every case:

a) Unless the spacecraft has multiple beacon frequencies which are active simultaneously, observations should be restricted to the highest frequency available. This will minimize ionospheric effects. If simultaneous observations of two widely different frequencies can be made (i.e., 29.5/435.1, OSCAR-7), a first order correction for the ionosphere can be made (Davies, 1969).

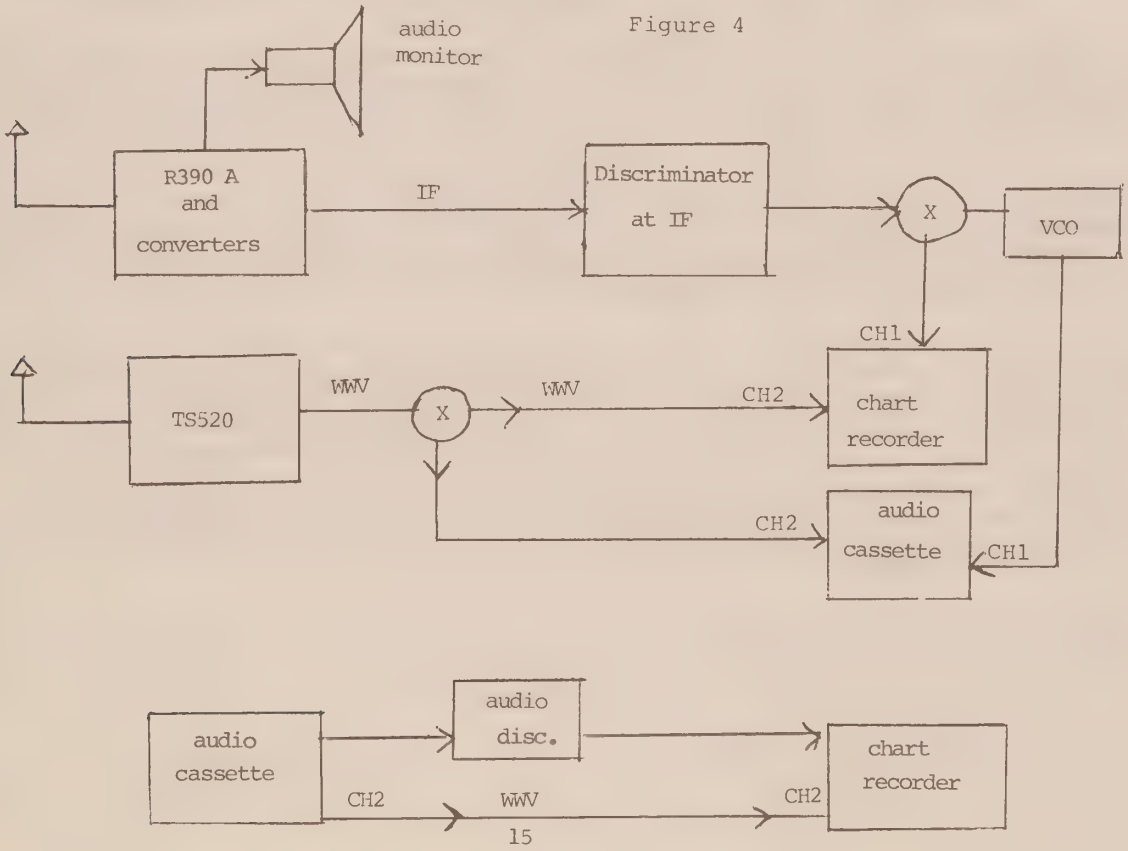
b) The most precise time standard available is required. For most amateur purposes, it suffices to record WWV at the same time as the doppler measurements. If an audio tape system is used, it is best to record WWV on one channel. In professional work, the very low frequency stations such as WWVL, WWVB, NBA, NSS or MSF are usually the ones recorded.

c) Most communications receivers do not have enough low frequency response to allow a precise measurement at zero beat. To determine the frequency in the vicinity of TCA, one either has to modify the low frequency response or else introduce a fixed bias in the tone at audio frequencies. One way to do this is to voltage control the BFO and use the control voltage as a measure of the doppler shift.

d) A stable receiver and receive converter is essential to the success of the measurement. A long (several hours) warm-up period is mandatory for tube-type equipment. For the most precise measurements, extra thermal insulation for the receiver VFO and the converter oscillator may be needed.

As an example of what is needed, the doppler system at WA3NAN (Figure 4) will be described. The basic receiver is an R390A which runs continuously. The VFO has extra thermal insulation around it. The 2 meter and 70 cm converters are conventional units which are allowed to warm up for at least 2 hours before measurement. For doppler tracking, the IF is fed to a modified VHF Engineering discriminator. The output of the discriminator is proportional to the frequency of the signal into the converter. One axis of a dual trace chart recorder is driven by the descriminator output; the other axis is driven by a WWV signal from another receiver. For recording purposes the discriminator drives a precision VCO which is recorded on one track of a cassette recorder. The second track is used for WWV. Playback of the tape is through an audio discriminator (also VHF Engineering) on one chart trace and WWV on the other trace.

Figure 4



RANGING

Since about 1970, the doppler technique has been replaced by measurements of the round trip range to a satellite using specially designed transponders. Ranging measurements have the potential for more precise measurements then is possible for beacon doppler measurements. This is due to the fact that the "effective doppler shift" frequency of a transponded signal is the sum of the uplink and downlink frequencies.

The ranging process consists of measuring the time delay between the transmission and reception of a pulse on the ground. In the professional world, one of the biggest advantages of ranging is that the transponder maintains the strength of the signal returned at a relatively high level. Thus the very high power transmitters required for radar measurements are not required. Another advantage is the possibility of using counting and gating circuits to measure the delay between transmission and reception.

Practical amateur systems for ranging measurements have been discussed by Meinzer (1975) and Alas (1979). In each case, these systems record the round-trip delay as a function of time. Although a much more sophisticated analysis can be performed, the normal amateur practice is to determine a TCA from the time of minimum range and analyze the resulting TCAs in the same way as doppler data.

In performing range measurements, the following considerations apply:

(a) Uplink and downlink frequencies used for ranging through communications transponders should be near the mid-point of the bandpass. The closer one operates to the band edges, the greater is the "inside-the-satellite" delay and the faster the delay changes for small changes in frequency. A very small change in frequency at the satellite due to doppler shift can yield a large spurious change in delay.

(b) Given a choice, the highest input and output frequencies are preferable. For example, ranging through the Mode J transponder on OSCAR 8 is preferable to Mode A. Distortion of the downlink pulse by the ionosphere can make it exceedingly difficult to judge the beginning of the downlink pulse.

(c) A ranging pulse should have the sharpest edge consistent with the rules and good technical practice. The limiting factor in the accuracy of most ranging systems is the ability to find exactly when the downlink pulse begins. If the edge of the pulse is not very sharp to begin with, the job of defining the pulse beginning is that much more difficult.

Ranging systems are not standardized as yet. However, with the advent of the Phase III satellites, we should expect to see the basic system become standardized very soon. Although it may soon be of only historical interest, the ranging system at WA3NAN used for OSCAR 8 (Figure 5) is similar to most current systems.

The basic ranging signal is the Morse letter A and the range is determined from the leading edge of the "dit". A dual trace scope is triggered on the transmitted "dit". One trace is the transmitted A and the other is the received A. The delay is proportional to the length of trace between the trigger and the received dit. If a crystal controlled sweep is used, a good measurement of the delay can be gotten right off the screen.

In practice, the actual system is more complex to eliminate bias. The transmitter pulse gates on a counter with an oven crystal time base. The counter operates at a 1 MHz rate so a 1 microsecond basic accuracy is possible. A second gate stops the counter when the leading edge of the received "dit" occurs. The counter display is held during the range transmission and count and updates when the "range gate" triggers. The letter A is transmitted at a 1 character per second rate with the leading edge of the "dit" on the second mark. A digital clock synced to WWV is used to display the time during the measurements. The range values, automatically in microseconds since the clock rate is 1 MHz, are logged each 5 seconds during the pass.

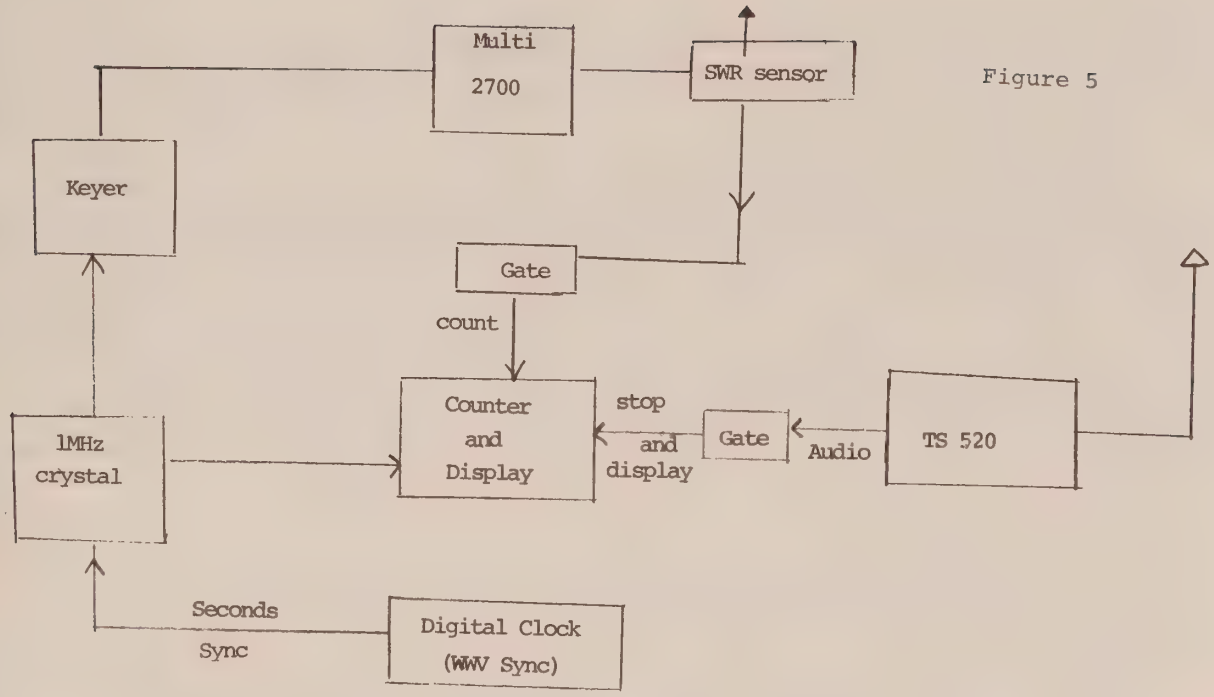


Figure 5

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Meinzer, K. 1973, Range Measurements with OSCAR 6, QST, May 1973, p. 36.

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PHASE III SATELLITES AZIMUTH AND ELEVATION TO APOGEE

By Roy D. Welch, WØSL

In March, 1980, an AMSAT Phase III satellite will be placed in a highly elliptical orbit. The satellite will be within range of many potential users when it is at or near apogee, the highest point in its orbit. For many users this will be the most desirable point in the orbit for communications through the satellite. For this reason, I have prepared a program for use with the HP-67/97 Programmable Calculators that will provide Azimuth and Elevation (AZ-EL) coordinates from any ground station to the apogee point of the Phase III satellite. The input required consists of the latitude and longitude of the ground station, latitude and longitude of apogee and the altitude of the satellite above the earth at apogee. The latter three items should be available from published orbital calendar information once the satellite is in orbit.

This program will also give the AZ-EL coordinates from a ground station to any satellite if the longitude and latitude of the sub-satellite point and the satellite's altitude at that point is known. This includes geostationary satellites whose sub-satellite coordinates and altitude are published.

Phase III satellites will spend at least two to three hours of each orbit in the vicinity of apogee. With antenna beam widths of 30 degrees more or less, most stations will have access to the satellite during this time without any trouble by just aiming their beams to the apogee AZ-EL coordinates.

The program is actually part of a larger program I have prepared for AZ-EL tracking of the Phase III satellites. The larger program uses all of the program memory of the HP 67/97. This abbreviated version for AZ-EL to apogee may be short enough to be adapted to other small programmable calculators.

For futher information please send an sase to Roy D. Welch WØSL, 908 Dutch Mill Dr., Manchester, MO 63011. Note that the full AZ-EL Program is in the HP Users' Library.

SUCCESS AT LAST WITH OSCAR 8 MODE J

By Frank M. Wiesenmeyer, K9CIS

The subject of OSCAR 8 Mode J has become somewhat controversial and confusing to many satellite users, so I thought an article on "how to do it" was in order. Many amateur satellite operators have found their initial attempts at using Mode J to be disappointing at best and some have even experienced the ultimate failure of hearing nothing at all. Admittedly, the signals from OSCAR 8 Mode J are not real strong, but they do exist, contrary to some erroneous rumors, and they can be heard loud and clear with the proper receiving equipment. In comparison with Mode A, there is almost no "man-made" interference, such as power line hash. Ionospheric related interference, such as QRM due to terrestrial communications, is almost non-existent. In short, Mode J is a superior mode for satellite communications similar in many ways to OSCAR 7 Mode B. The purpose of this article is to share with you some of the secrets of successful Mode J operation, so that you too can join in on the fun and excitement of AOS to LOS rag chews using this superb transponder.

Early Attempts & Failures

I started my satellite career with OSCAR 7 Mode B, and got spoiled right from the start. I had high standards of comparison set for OSCAR 8 Mode J and I must confess, my early attempts were a disaster. But, read on! A few months later, disaster had changed into success.

About the time OSCAR 8 was successfully launched, I ordered my Hamtronics C432-5 70 cm UHF converter kit. I just could not stand the thought of a new satellite being in orbit and not being able to hear it. You will recall that OSCAR 8 started out in Mode J until it had stabilized sufficiently for deployment of the Mode A antenna. Just before launch, the experts were predicting that it would be about a week, or maybe longer, before the satellite stabilized and could be commanded into Mode A. That was too long for me to wait, so I called Hamtronics and ordered a converter kit over the telephone. They said that they could ship it right away, but that they were out of crystals! Well, the converter showed up on March the 9th and I had it built in one afternoon. Luckily, I found a crystal in my Heath HA-202 FM rig that would work in the converter until the factory sent the 45.222 MHz rock that converts 435.0 to 28.0 MHz. After going through the simple alignment procedure, I was able to hear a noisy 0.3 microvolt signal at 435.1 MHz on my P4C receiver with the HP8654A signal generator from work connected to the converter. This was encouraging and verified what Hamtronics claimed in their specifications. I calculated the first available "in range" orbit and listened with my UHF TV antenna, used for TV DXing, and heard absolutely nothing! OSCAR 8 was not in Mode A, as I did not hear anything on 10 meters either. I had been tracking OSCAR 7 successfully for months, and use of the Oscarlocator had become pretty routine. However, just to be sure Murphy wasn't working overtime to foul up my first attempt to hear Mode J, I checked and rechecked the calculations, but found no error. Several more passes produced the same results. My UHF TV antenna, by the way, is a 6 foot parabolic and it has a low noise broadband preamp mounted right at the antenna, which later proved to work reasonably well on relatively distant low elevation angle passes.

The next attempts at hearing Mode J were made using the Cushcraft 432-20T, 20 element circularly polarized antennas used for Mode B operation at the college where I teach Electronics. The results were again the same; nothing, not even a faint trace of a C.W. signal or of the Beacon. There was a reason however. By necessity, I had used about 150 feet of 8237 RG8 coax between the antennas and the shack at the college and the UHF loss (about 7 db) was eating the relatively weak Mode J signals alive! You must remember that I was still thinking in terms of OSCAR 7 Mode B, where the downlink was so strong that almost anything worked! When one considers the fact that we were only running 8 watts output on 432 MHz when operating Mode B, it is quite a tribute to the sensitivity of the AO7 Mode B transponder that we worked out so well on Mode B with this obviously less than ideal 70 cm setup at the college. So much for failure!

First Taste of Success

Now, let's get to the success part of the story, which is the part you are undoubtedly most interested in. I called ARRL headquarters and told my sad story to Bernie, W9KDR/1. He said not to give up and that a lot of people were hearing Mode J well. Bernie confessed that the signals were not as strong as on Mode B, and that it was just a different ballgame listening at 435 MHz. He added that you need a low noise figure "front end" preferably, with the preamp mounted right at the antenna. That sounded familiar; just like UHF TV DXing, which consumed most of spare time before I started chasing amateur satellites. Unfortunately, I had to

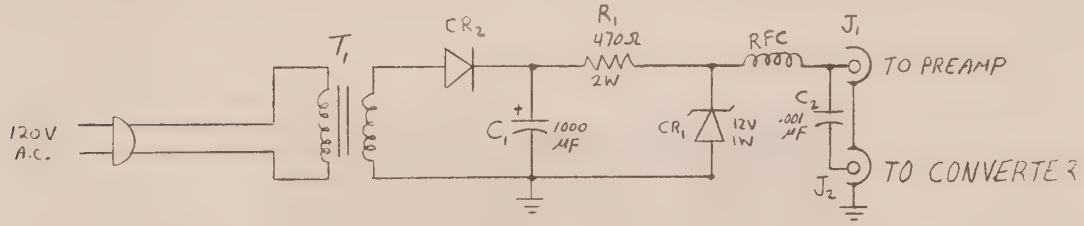
wait a while to try Bernie's suggestions due to moving the family residence across town, which we did during the Easter ice storm of March 1978. On top of that, I was just plain fed up with Mode J and not too anxious to get back to work on the project. Along about mid-April the crystal for the converter finally showed up and somehow, I thought that maybe this was a sign that my luck was going to change.

My first success at hearing Mode J was more like a failure, but I did hear it at the new house when I got my Cushcraft 435-20T antenna up on the chimney with only 30 feet of RG8 coax leading to the converter. I could not hear the 100 mw beacon, but I could barely make out the stronger CW stations in the passband near TCA on close passes.

Improvements Come a Few db at a Time

With this very modest but important bit of success under my belt, I next ordered a Hamtronics P-15 435 MHz JFET preamp, which soon arrived and turned out to be as easy to build and to align as their converter. Indoor tests, on the bench, showed that the addition of the 70 cm preamp noticeably improved the sensitivity of the converter. I could now hear -130 dbm (.07 microvolt) signals reasonably well. However, the major advantage of the preamp was that it could be remotely powered and conveniently mounted outdoors at the antenna. A quick check on Orbit 1748, July 9, 1978, with the preamp indoors, produced my first Mode J telemetry. Signals were 339 to 449, nothing spectacular, but I was at least hearing the Beacon! Before the next orbit, #1749, I climbed up on the roof and mounted the preamp right at the antenna. For this first test a 9V battery was used to power the preamp outdoors, but it didn't take long to discover the inconvenience of running outside and climbing to the roof to disconnect the battery. Worse yet, I left the battery on all night a couple of times and that started running up the cost of batteries. After a few days of this routine, I built the 12 volt remote power supply shown in Fig. 1, with the +12V operating voltage sent up the coax, which is a standard technique for remote powering TV preamps. The only modification to the preamp required was the addition of the 6 to 8 turn RF choke as shown in Fig. 2. The power supply I used was a converted TV preamp power supply that I happened to have on hand, but the circuit could just as easily have been built in a minibox or other similar utility box. The results were quite impressive; dramatic in fact! Moving the preamp to the antenna, which only offset approximately a 2 to 3 db loss in the 30 feet of coax cable made a big difference. This result reminded me of what Bernie had said, "Every db of loss counts at 70 cm." It still wasn't Mode B, but I was hearing the beacon 569 on distant passes and 599 when the bird came in close. Best of all, there were no desense problems when the uplink was keyed. KØRZ was my first

Figure 1. Preamp power supply circuit showing method of duplexing DC operating voltage on coax transmission line.



CR_1 12V, 1 watt zener Syl ECG 142 or equivalent

CR_2 Silicon rectifier, 600V PIV, 1A, 1N4005 or equivalent

RFC not critical 6 to 10 turns air core, wound on 1/8" diameter dowel or other form

T_1 22-24V RMS at 20 mA transformer

J_1 J_2 BNC, N or F (TV type) coax connectors

C_1 1000 μF, 35V electrolytic

C_2 .001 μF disc ceramic, 1KV

R_1 470Ω, 2W carbon or film, 10%

Mode J QSO on Orbit #1847, July 16, 1978. I was finally on Mode J and finding out where all my friends from Mode B had gone. However, the QSB was still somewhat of a problem and not every pass was the same. One thing you learn quickly after operating Mode J for a while is that the performance is sometimes inconsistent and unpredictable, with some passes just producing better signals than others. The secret is to have sufficient fade margin so that you can afford some QSB.

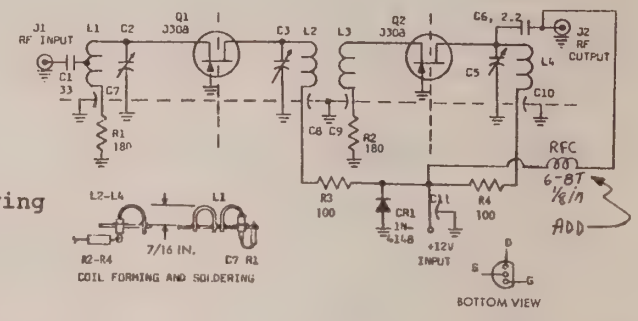


Figure 2.

Hamtronics 435 MHz Preamp Circuit Showing Placement of Added RF Choke.

The initial uplink, incidentally, was very simple: just an old Gonset Communicator IV, crystal controlled 2 meter AM rig, converted to C.W. and running 10 watts output to 30 feet of RG8 coax. The uplink antenna was an AZ-El mounted Cushcraft 144-10T 10 element RH circular polarized antenna up 25 feet on a chimney and rear mounted beside the 432-20T 20 element 435 MHz antenna. For those not familiar with the 144-10T, it consists of two 5 element gamma matched yagis mounted at right angles to each other on a single boom as shown in the photograph of Fig. 3. The 90° delay line produces right or left hand circular polarization, depending on which antenna gets the delay line. I should mention that a problem was encountered elevating these antennas with the U-100 rotor as suggested by Cushcraft. I found that mechanically balancing the antennas, by moving the mounting point on the 2 meter antenna toward the center of the boom was necessary. I did not like this arrangement, however, because the side stacking boom passed through the elements of the 2 meter antenna. It did work alright mechanically, but it seemed like Mode B signals faded more with the 2m antenna mounted near the center of the boom. I had previously had the 2 meter antenna rear mounted, but at a fixed 30° elevation angle for Mode B operation.

One way to get a U-100 rotor to elevate the rear mounted antennas is shown in Fig. 3, where an extra boom and counterweight (old rotor) have been added to balance the system mechanically. I have been using this system now for 8 months with no problems. A rotor with more torque might be a good alternative, but this approach would no doubt require a new elevation rotor mounting bracket. It is interesting to note that the picture in the Cushcraft catalog and OSCAR antenna brochure shows a Blonder Tongue U-1000 rotor being used. This rotor has more torque, but does not fit the mounting bracket supplied. BT recently discontinued this rotor.

Approximately 145 enjoyable Mode J contacts were made with this 10 watt system up until November 18, 1978, when I added a Heath HA-202 40 watt P.A. for distant passes. I had tried using this type of P.A. earlier in the summer, but it generated far too much static in the downlink to be useful. My brother AC9V/6 brought his HA-202 home with him at Thanksgiving and surprisingly, his amplifier was clean. The addition of the 40W P.A. was of some help in maintaining a signal in the satellite on distant passes. One thing I did notice, in particular, was that when the satellite was very busy with a lot of strong signals in the passband, I did not find my signal abruptly changing level due to AGC action with the amplifier on. On distant passes, without the P.A. I was accustomed to hearing my signal suddenly disappear or change signal strength abruptly, when a strong signal somewhere else in the passband would hit the transponder hard.

70 cm Antenna Improvements

At this point I still was not satisfied with Mode J, because I still did not hear it as well as the old Mode B. But, with OSCAR 7 ailing badly, there was nothing else to do but to try to improve the downlink some more on Mode J, with Mode B, as always, the standard for comparison. I had tried improving the impedance match below 2:1 value set at the factory, with simple adjustments to the gamma matches. For these tests, a Bird Model 43 wattmeter was set up on the roof, close to the antennas to get the most accurate VSWR readings. One of my students and I then spent an afternoon talking back and forth on walkie talkies, while I made the adjustments to the gamma match and he keyed the transmitter after each adjustment to check the results. Unfortunately, no improvement could be obtained. Several months of experimenting with the 432-20T, plus on the air experience finally led me to believe that some improvement in the downlink might come from a better 435 MHz

antenna. Since I had read where several antenna investigators including Dr. Paul Mayes, at the University of Illinois Antenna Laboratory had experienced considerable difficulty in using the gamma match at 435 MHz, I decided to try finding a better 70 cm antenna design. Improved bandwidth was also a consideration in selecting the next antenna and the KLM 420-470 seemed to be a good choice with its log periodic driver and sleeve balun. From a purely visual inspection of the KLM antenna, I was particularly impressed by their use of a type N connector on the balun instead of the outdated and lossy SO-239 type used by some other manufacturers. So, on Nov. 15th I bought a KLM Model 420-470 14 element yagi, along with their expensive ($25.00) balun and hurriedly installed it in place of the Cushcraft 432-20T. The KLM 14 element hybrid LP-yagi turned out to be a very good choice. Nothing else was changed, so as to get a fair comparison between the two antennas. Even though the KLM antenna is not circularly polarized, I found that it worked noticeably better than the Cushcraft. However, I still did not see the dramatic improvement I was looking for. The pattern on the KLM antenna is exceptionally clean and the front to back ratio measured consistently greater than 20 db across the band, even at TV Channel 15, indicating exceptionally wide bandwidth. The impedance match was excellent with a flat VSWR of 1.1 across the band 432-435 MHz. Overall, a small but significant improvement was made, but not the big "breakthrough" I was looking for.

The Big Breakthrough

If you haven't noticed the pattern yet, the challenge of Mode J is met a few db at a time and every last db counts! But the one big improvement I had been hoping for finally came after Christmas. I had decided that an ultra low noise figure was the only thing left to try. If that didn't produce significant results, I would have to give up and conclude that Mode J would never come close to Mode B performance with respect to downlink signal to noise ratio. I, therefore, ordered a Janel 432-PC preamp around Christmas, since Bill, KØRZ, was using one and he always seemed to hear my signal better than I heard myself. His preamp was not even mounted at the antenna, but no doubt his use of "hardline" probably allowed him to have this convenience without seriously degrading downlink performance. Heavy winter ice and snowstorms prevented me from trying the new Janel preamp in my downlink system for a month and a half after it arrived, so I settled into building the Heath SB-500 transverter that my brother had given me for Christmas, until a break in the weather permitted further experimentation with the outdoor mounted preamplifiers. Building the SB-500 got my mind off the weather outside and gave me high hopes for a Mode J SSB demonstration for the students at the college. The convenience of VFO operation with the SB-500/T4XC combination also sounded good after 6 months of crystal controlled Mode J operation at 145.970 MHz with the Communicator IV. This is a good frequency, by the way, if you must operate crystal controlled. The only problem with the SB-500/T4XC marriage was getting 28 MHz drive from the driver stage without disturbing the normal 10 meter operation of the T4XC. Obtaining 28 MHz drive from the shielded slug-tuned driver coil in the T4XC initially seemed difficult, if not impossible, but with the help of K9KKI in Springfield, that problem was quickly solved. I think the solution to this problem was so clever, that it is deserving of a separate write-up in a future newsletter article.

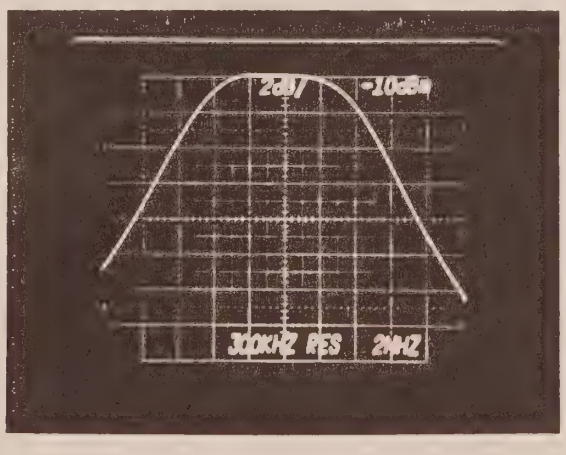


Figure 4. Narrow band frequency response of UMN-3 BPF.

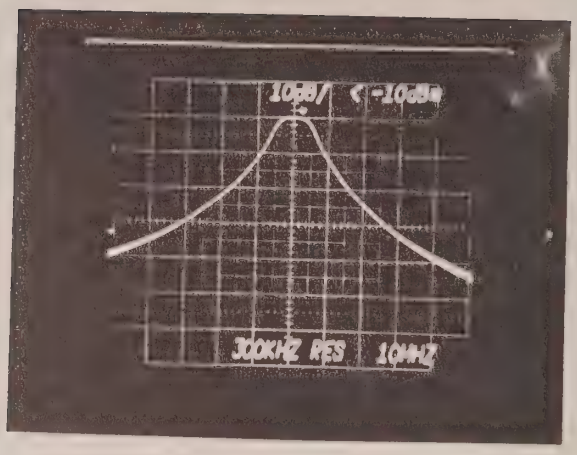


Figure 5. Wide band frequency response of UMN-3 BPF.

With that project completed, and a break in the weather coming along on February 8th, 1979, I finally got a chance to get to the roof so I could install the Janel 432PC high gain low noise preamp. The same remote DC power supply used with the Hamtronics P-15 was used with the Janel preamp. The new preamp was first checked out in the house with a HP8654A signal generator and it promptly showed its potential. Signals of -140 dbm (.022 microvolt) were easily copied with a good signal to noise ratio. This system was far superior to anything I had ever tested before. With the Hamtronics P-15, I could barely hear anything at the -140 dbm signal level. Unfortunately, I do not have access to noise figure measuring equipment, but I tend to believe the factory data on the tag tied to the box which showed a measured noise figure of 2.0 db. Off the air signals soon revealed what a [illegible] noise figure preamp mounted close to the receiving antenna can do to improve weak signal reception at 435 MHz. I listened to Orbit #4733, Wednesday evening, February 8, 1979, which was the tail end of a Mode J experiment day and the results were nothing less than sensational! I heard the beacon on a distant 48.4°W, easterly pass like I had never heard it before in 7 months of Mode J operation. There was no doubt about the results of this change; it was fantastic! I tried a quick QSO with Dick, W8DX, since it was now Thursday, UTC, but, "hold it" I had a new problem:"desense". Keying the transmitter wiped out everything in the downlink! By now, I had heard enough to know I was going to find some way to use this bipolar preamp, no matter what kind of filter it took. In a note from W9KDR, he explained that many Mode J users were using cavity type band-pass filters ahead of their receiving "front ends" to eliminate desense problems. I had more than a desense problem however; I could not hear a thing from OSCAR 8 when the transmitter was keyed. Obviously, a good low insertion loss band-pass filter was needed and I just happened to have a Jerrold Model UMN-3 cavity type TV bandpass filter-mixer on hand, which I hoped would do the job. I took it down to the college where I work and realigned it to 435.1 MHz using a Tektronix 7L12 spectrum analyzer and TR-502 tracking generator. The insertion loss measured only 1 db, so I was hopeful that this filter would take care of the interference. Incidentally the Jerrold UMN-3 UHF TV filter is not any less expensive than the 50Ω unit made by Janel and others and you will not save money taking this approach. I just used it because I happened to have one on hand. The excellent selectivity of this filter is shown in Figs. 4 and 5 which are just two views of the same filter, one being expanded to 2 MHz per division on the frequency axis and 2 db per division on the voltage gain scale. The next day, I installed this BPF ahead of the Janel low noise preamp, and every last trace of uplink interference and UHF TV transmitter QRM disappeared. The fantastic sensitivity of the 435.1 MHz downlink system, fortunately, did not disappear! I have been riding a high the past several weeks that is hard to describe and with each Mode J pass I have become more convinced that I have finally found the main secret to closely approaching Mode B performance with Mode J. At times Mode J is every bit as good as Mode B used to be before the Fall of '78, but the consistency is still not always there. But the results are close enough to satisfy me and I can assure you that I am as particular as anyone else who got spoiled by Mode B.

Perspective

Why must we be so careful in designing our downlink systems for receiving Mode J? Why does every db make such a difference? Well, the Mode J beacon runs only 100 mw and the entire transponder has only a 500 mw average power output or approximately 1 watt PEP output. A healthy Mode B on the other hand runs 10w PEP most of the time, which is 10 db or about 2S units stronger! In addition, we have a unity gain $\lambda/4$ monopole downlink antenna on 435.1 MHz on OSCAR 8 Mode J, instead of the circularly polarized turnstyle antenna with about 5 db of gain on OSCAR 7 Mode B. Finally, the Mode J antenna does not seem to be optimally positioned with respect to the satellite Z axis and the Earth. However, the successes of OSCAR 8 Mode J are truly amazing. Almost all of the many satellite systems work perfectly. There are no malfunctioning telemetry channels, no noises or oscillations or other distortion in the passband. The telecommand system works flawlessly and the batteries have proven to be very hardy.

Recent comparisons of the Stanford P76-5 satellite and OSCAR 8 indicate that there is nothing at all wrong with the Mode J concept. P76-5 with its 200 mw beacon is every bit as good as the Mode B beacon and in fact is actually stronger and steadier with respect to fading. I am convinced that the difference is in the antenna and its orientation. The 3 db power difference could not possibly make as much difference as is observed between the AO8 and P76-5 beacons.

P76-5 hardly fades at all and the signal level changes very little from AOS to LOS. I think a close look at their antenna and attitude control systems should be undertaken, which will no doubt prove to be very interesting and valuable for future AMSAT satellite designs in the Phase III era. Hopefully, later Phase III satellites will bring the Mode J concept to its full potential.

Future Improvements in Mode J Operation

Most amateurs are really never satisfied, at least not for long, with their station performance. We are always looking for ways to make our QSO's easier and more enjoyable. It appears that a better understanding of the OSCAR 8 Mode J antenna orientation during the course of an orbit would be helpful. Currently, several enterprising Mode J satellite users including KØRZ, W7US, W1VD, WB9GCV and W9KDR are experimenting with polarization switching of both uplink and downlink antennas. Early results indicate that at times the improvement is dramatic and at others, there is no change at all. Hopefully they will be writing up their results soon, so that we can all take advantage of their findings. Also, there is no doubt that a truly circular polarized receiving antenna would do a lot to help reduce the fading, which at times still plagues Mode J signals here. Even though I now have sufficient fade margin, so that I seldom, if ever, lose the beacon altogether, it would be very desirable to reduce this affect. I have, therefore, begun construction on a 6 turn 70 cm Helix antenna, designed by W7US, which hopefully, will be up soon and producing some more results on this approach to reducing QSB. In the meantime, get on Mode J and start enjoying the best Mode we have now that OSCAR 7 Mode B is about gone and Phase III is a year away. I can assure you that the results will amaze you!

K9CIS at his station

Letter and Comment

Dear Joe,

My QTH is in Libreville, Republic of Gabon, latitude 0°10' North, longitude 351°30' West.

I have been trying to contact OSCAR 7 and 8, to look for contacts in Europe, but without result.

I have only been able to contact S. Africa and the Ivory Coast. I think that OSCAR 8 is too low in altitude.

However, I am very surprised to hear many American stations which operate in the band reserved for the reception of the satellite working in MODE A, especially in 29.502, exactly in the same frequency as the telemetry of OSCAR 7.

I am disappointed that the unskilled Americans are not able to respect the portion of the band reserved for satellite communications.

I await with impatience the launching of Phase III satellite, which I hope, will enable me to contact Europe and America. However, I am not satisfied with the choice of frequency of Phase III satellite. I feel it is too low. I would prefer a higher frequency 2 GH_z to avoid local interference.

I hope that the next satellite will utilize a higher frequency because, if not, the spirit of the amateurs will be broken.

L. Bertucci
B.P. 392
Libreville, Gabon

Dear Sir:

One item of interest that could be included in the next Newsletter is another way that I have found to solve the downlink desense problem when operating OSCAR 8 Mode J. When I recently experienced the problem myself, I didn't want to spend a lot of time making a cavity from scratch. I had about six, 450 MHz GE Progress Line FM receivers in the junk box so I removed the front end cavity from one of them and used it in the antenna feed line. This cavity has phono type input and output connectors. As far as I can tell both by signal generator checks and on the air, the insertion loss is negligible. If this item has already been published, please excuse the duplication.

73,

Robert J. Diersing, N5AHD

Dear Editor,

I recently acquired a Tempo S1 synthesized handi-talkie for 2 m FM, also known as the Trio AR-240 outside the U.S.A.

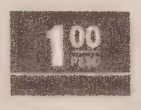
Using only the integral 19-inch whip antenna, I have found that I can consistently access OSCAR 8, Mode A, under light loading conditions during overhead passes. Using makeshift CW keying with the push-to-talk bar, my peak measured downlink signal-to-noise ratio thus far was 19 dB, although values of 5 to 10 dB are more common. For reception, I use a Collins 74S-1 receiver in the 500 Hz CW position, which receiver has been converted to 100% solid state with W6DLQ's Skytec modules. The receiving antenna is a 3-element monoband Yagi. By far the most significant factor in determining downlink S/N ratio with such low power is passband loading of the satellite. The peak value of 19 dB was measured during Orbit 5696, an "experimental" orbit, during which I also heard brief snatches of FM from my hand-held as well as CW.

There are two "morals" to this story. First, high power is not needed for satellite operation unless QRO operation by others forces one to it in self-defense. If all users keep their power down, everyone benefits. Second, if even a simple hand-held can access the satellite, imagine what more powerful

FM mobile and base stations can do by way of QRM to satellite operation. The incidence of FM interference has been rising steadily. Readers should work to encourage all terrestrial stations not using OSCAR to avoid transmitting in the satellite's passband.

Using W1HDQ's value of -5 dBd gain for a quarter-wave whip mounted on a hand-held 2m tranceiver, the estimated ERP for my Tempo S1 is about 0.5 watt.

73,



Ray Soifer, W2RS

(Sounds good Ray -- As a follow-u . . who will be the first to make a QSO using an S-1 and a converted CB walkie-talkie as a Satellite communications walkie-talkie.)

Dear Joe:

Regarding June 79 edition:

1) If it would save in publishing costs,a newsletter the size of QST, I believe, would be desirable.

2) Yes, I believe we should accept a few good ads to help with the publishing costs.

3) An excellent idea to have moonbounce, etc., or anything from or to space could be included if it would help circulation and increase interest.

Everyone at AMSAT seems to be doing a good job, keep it up.

73,
Larry Briggs

Dear Joe,

I read your Editorial in the June 1979 edition and the proposals that have been brought out are fascinating. However, I do believe the scope of the magazine should include suggestions by the membership in where we should go in space after Phase III and SYNCART, taking into consideration the expense and the technological sophistication required for such ventures.

Will we decide to construct amateur planetary and lunar probes, amateur versions of Landsat, or should we begin to work on what could be a space first, an amateur solar powered satellite?

I suggest the last proposal for a number of reasons: First of all, study needs to be done on the effects of microwaves beamed from space, on the practicality of converting these microwaves into usable electricity, and so on. One scheme would be to place a small, primitive SPS in a synchronous orbit (like SYNCART), and beam the microwaves to a radar antenna either at Goddard, or into the relatively uninhabited area of the Green River Valley where our oil shale fields lie. Perhaps, we could obtain a grant from the oil companies (God forbid!) for this project. Exxon, I believe, is working on a method to use microwaves to separate the oil from the shale. We could provide the power for their project and they could assist us in the expense - for a small, primitive SPS, capable of one megawatt of usable power could run us to perhaps one million dollars.

It does seem burdensome, but the professionals are having a difficult time convincing the Congress to begin experimentation with the SPS - or for that matter with other aspects of the Space Program. It might be time for us to consider the challenge for we are supposed to be in an energy crisis, and this might be the way out of it. I will contribute what I can to the organization, financially- or I could contribute my suggestions for future projects like those above to the Newsletter as an author. My articles will not be technical, for my expertise in technical matters or even in electronics is nill - but from time to time, I will have a brainstorm, and I would like to share it with the membership.

Very Truly Yours,
Anthony E. Meyer

Dear Joe,

A need for better communications between all of us - especially in light of the launching of Phase III (A) approaching us. March 5 of 1980 is not that far away!

We don't even have 'official' correction figures for the W3IWI-W6PAJ orbit calendar yet, although we hear that a new calendar will be coming out soon.

I propose that some of us form a c.w. net - no doubt many of you would say oh no, not that old fashioned c.w. - I don't care. However, I'm pretty sure that a surprisingly high percentage of you guys will agree and even join in IF AND WHEN we actually form a net.

Semi-breakin at about 25-30 w.p.m. could be very efficient, you know. That's what Jack, W3OZ, and I actually do, on Saturdays and Sundays. Okay, here are the frequencies and times/days:

Saturdays at 1100-UTC on 14,099 KHz
Sundays at 1200-UTC on 14,099 KHz

Alternate frequencies are: 21,099 and 28,099 KHz.

How about it fellas? And if the above freq/time/day doesn't quite fit into your local situation, please do let me know. I will try to do my best to make adjustments.

Slow speed only operators need not worry. As soon as we can clear the high speed net, so to speak, I for one will come back using a straight key, if that's what you ask. I'd say, slow speed communication is far better than NO COMMUNICATION!

Some of you might ask, why 14,099 KHz? This freq. was 'discovered' by Jack and I, after many many years of weekend skeding. This freq. is the least interfered by 'country' counters, contesters and so forth.

I'll tell you what. I'll make it a point to 'watch' this 14,099 KHz whenever I have nothing else to do while I am in my shack. Every 5 minutes or so, I'll blast out a "CQ AMSAT" - a short one though, "cse I hate long CQs!

If and when, or as soon as 21 MHz gets better at this QTH, I'll do likewise on 21,099 KHz.

Let me hear from you, by letter, or much more preferably on c.w. on 14,099!

73 from Haruo Yoneda, JA1ANG, N3AMW
15-1305 Shimouma 2-chome-26
Setagaya-ku Tokyo 154 Japan

P.S. Currently the Asia-Pacific AMSAT Net is on 14,275 KHz at 1100 UTC every Sunday. Upper Sideband of course! Please join us if you can.

Dear AMSAT Officials:

Herein is my membership plus modest contribution to your cosmic-size project. I am a maritime mobile educator launching a network focussed upon world friendship among teens of the globe. We shall research the problems facing all our cultures, swap problem-solving ideas, etc. One of the foci of our "Planetary Citizen" program is to raise the consciousness of UNESCO club members in every country, plus the other international youth organizations, as to their need to persuade THEIR governments to allocate frequencies for amateurs!!!

Our program is a totally non-profit, volunteer program and most school districts are happy to enhance their alternative school offerings with donated boats and teaching, granting school credit for the integrated curriculum outlined in one of my enclosures. The Osceanic Society is sponsoring us, but unable to provide any funds as yet...and Operation SHARE is coalescing their tutorial plan with our blue-spangled scene. So we're getting more backing and cooperation every day....just finished a cruise with 19 high school youngsters from Miami to Venezuela, forming clubs on every island, leaving code oscillators and ARRL booklets and cooperative school officials in our wake. Have one our Santa Cruz grads touring Japan right now visiting the high school electronic clubs and enlisting their skills on behalf of our "cause".

All this is to plead for a predictable schedule via your AMSAT Phase III Satellite for our "Planetary Citizen" program network. I feel that the energy crunch will increasingly necessitate priority use of our frequencies, with educational goals superceding contest and ragchewing perhaps.

I am especially eager for any advice, suggestions or criticisms of our program, because I am a relatively new ham with a lot to learn.

So, if you could promise us a regularly scheduled access to a frequency, say once a month or so, I can hear the pens in heaven already scratching your names. Come to think of it, they're already doing that, even if you can't promise.

Mary B. Duffield
WA6KFA

(I don't see why not, see the article on the Phase III passband in the last issue -- Joe).

Gentlemen:

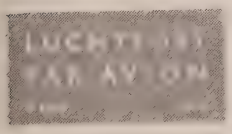
In reply to the March 6, 1979, East Coast AMSAT Net (3850) and the NCS's statement about not shutting 2 to 10 meters down, as some have requested, I say thank you!

I would not have joined AMSAT (pending) and would not be making plans for the future in satellites if it wasn't for 2 to 10 meters.

I'll get around to 432/435 soon but I can't do everything at once. (Hi)

As the NCS said, 2 to 10 is the beginning. Please don't do away with 1st base.

73,



Eddie Kuykendall
W5UXP

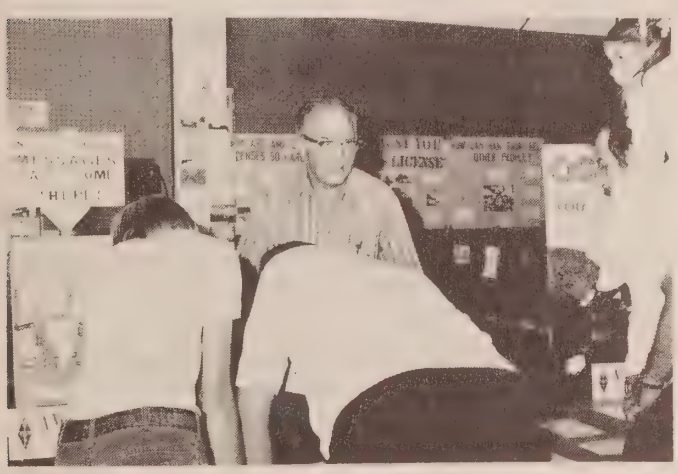
TF3IRA has now been QRT on OSCARs for some time as we have been moving our club station into a better house from which we hope that we can keep the club station active in the years to come. In the meantime, I do know that TFØDFT has worked through the OSCARs and I hope that I will also soon be on the air when I have finished the 2m transverter I am now building.

We received your Newsletter a year or two ago, but I haven't heard anything from AMSAT via I.R.A. since. But I am sure that we can keep uo good activity from Iceland soon, not at least when the Phase III satellite will be in the air.

Lastly, any information from you on the satellites will be greatly appreciated. By the way, I have not found any information on the polarization of the antennas aboard OSCAR 7, 8 and Phase III anywhere.

Kristinn Andersen
TF3KX

WALT DIXON W4DWN, AMSAT Rep and Dade County ARES (FL) member holds down the DADE COUNTY YOUTH FAIR Amateur Radio booth. Over a half million persons visited the Fair. CW, SSB,FM,OSCAR and RTTY were on display. (Photo by WA4PDM)



Dear Sirs,

Here is a little report on amateur radio and OSCAR activities as well as interests here in Iceland. I expect that you don't hear much from us, so this might be better than nothing.

I am, myself, a licensed amateur radio operator, TF3KX, and have been since 1975. Being at the age of 20, I am studying electronic engineering at our University, In our national amateur society (I.R.A.) we have about 100 licensed radio amateurs, but there are perhaps 20-30 active ones. The interests within our hobbies are just as many as the individuals, DX, VHF-work, technical matters, RTTY, and so on...

We must admit that interest in the work of AMSAT has not been very much, but nevertheless it does exist. Just recently after I got my license, I was caught by the satellite-bacteria through TF3KB, who was then the only active OSCAR-operator via the club station, TF3IRA. I had access to a 10m receiver through which I listened frequently to both OSCAR 6 and 7. Besides other things, he taught me how to use the OSCAR transverter at TF3IRA and there got the chance to become active via OSCAR 6.

Attn: AMSAT Newsletter

Many people have apparently duplicated my Mode J preamp & I've received no negative replys. However - at least once a week, I receive a request for sources for the MRF 901/904. To cut down on my mail load could you please publish the following information.

Motorala MRF901's are available from Lunar Electronics, 2785 Kurtz St. Suite 10, San Diego, CA 92110 and Circuit Specialists, Box 3047, Scottsdale, AZ 85257.

MRF904's are available from ARCOS, W2GN, Fred Merry, Box 546, Greenbush, NY 12061.

73,

Joe, W1JR

Dear Joe:

It might be of interest to you and the AMSAT readers of the "Newsletter" to learn of how the Phase III design evolves and is being fabricated. In this case, I refer to "Florida Baked Spacecraft" in the form of fiber-glass epoxy molded channels.

Phase III design requirements identified that the equipment modules would be mounted to a panel contained in the middle of each arm of the spacecraft. This panel, or web, is quite thin and needs stiffening overall and beefing-up in the area of module mounting points. Jan King and company had decided to bend some sheet aluminum for a channel stiffener in this area.

To provide a spacecraft that is tolerant of wide thermal transient events, such as earth eclipse, motor firing, and orbit injection it was decided that the equipment modules needed thermal conduction isolation, or decoupling, from the spacecraft. Most of the modules are also very low power dissipation and heat rejection could be handled by thermal radiation. It is undesirable, therefore, to have good metallic mounting conduction and suggestion of using a fiberglas epoxy intermediary seemed useful.

Reactions of dismay about "complexity" were observed about the mounting scheme, while assurances of the ease of implementation were being forwarded. The end result of the discussions being that if obtaining a specific fiberglas epoxy shape was easy that I was duly elected to proceed.

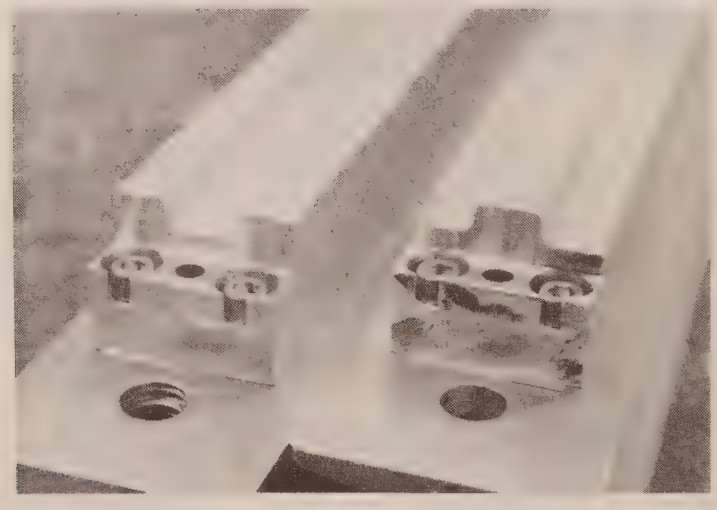


Figure 1 - Two-part Mold

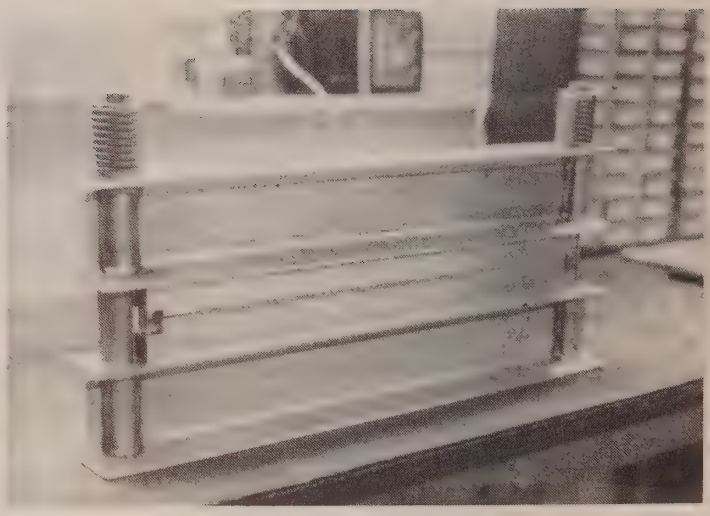


Figure 2 - Press Assembly

A "top hat" section channel stiffener was agreed and an unconventional two part molding method conceived so as to hold ±0.1 mm tolerances, Figure 1. Inasmuch as I did not have a convenient heated

Figure 3 - Dick Jansson, WD4FAB setting up mold for curing

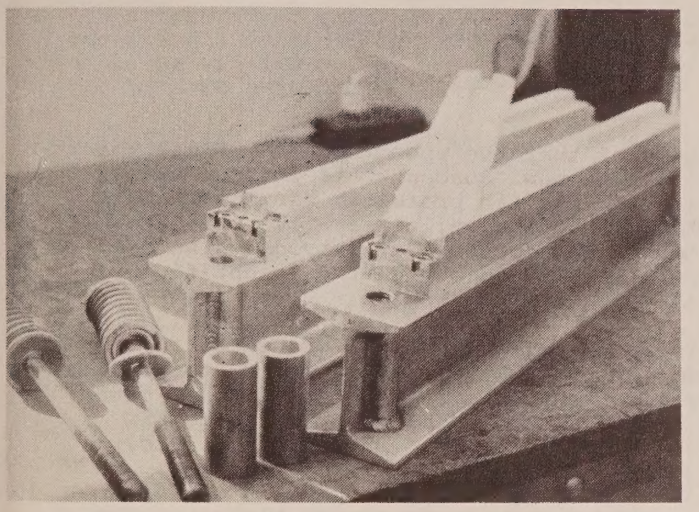


Figure 4 - Molded Channel Released from Tools

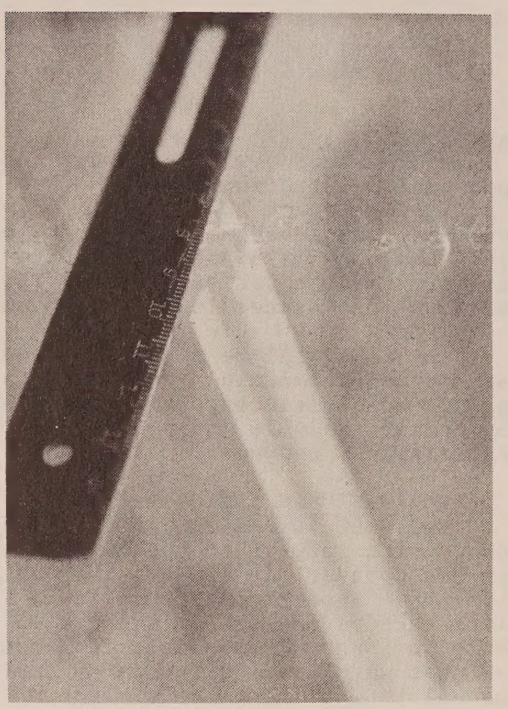


Figure 5 - Molded channel stiffener, 32mm wide, 8mm high, 400mm long

platten press to clamp and cure the material, a substitute was built of aluminum "I" beam stock and ½ inch bolts. Figure 2 shows the assembled press and molds. Heating of the molds and curing of the part was accomplished in the household oven.

Probably the largest hurdle to overcome was the use of the oven. My wife would be willing to "suffer" all of the expected odors in the good name of the AMSAT Phase III effort, but the grumbling was rather apparent. After curing a few parts, however, the odors were not evident and life became more bearable at our household.

Figure 3 is the author laying up a preimpregnated glass cloth layer in the mold surrounded by some of the hardware used in the processing. This scene was taken outdoors in March, but in Florida in comfort. Figure 4 shows the molded channel as it is removed from the tooling.

Fabricating one part at a time was fairly laborious, but suitable for a small run of parts needed for a couple of spacecraft. The job was far easier than it could have been, owing to the ease of handling the dry uncured epoxy impregnated cloth. No mixing of resins or any other mess was incurred. Curing of the part was done at 175°C (350°F) for one hour and total cycle times reached were as low as 2½ hours including a ½ hour mold release cure and two cooling off periods.

The end result of this effort is a technologically pleasing part that insures superior spacecraft conditions. It was also a satisfying part of the effort toward the Phase III flights and a happy family too. For sure this was a different way to enjoy amateur radio.

Regards,

Dick Jansson, WD4FAB

R 1400 BUDAPEST 7 5022 7

Dear Joe,

Regarding your "June 79" editorial, I have a few comments.

This magazine should be published 12 times a year, and be 8½ x 11" in size. Advertising is quite acceptable by me. A magazine format like "CQ" is F.B. here!

The format can be expanded to include other extra-terrestrial topics: EME prop., radio astronomy, galactic radio study and solar study.

Awaiting the outcome...

73,
Mike Zbrozek, K8XF

PHASE IIIA'S SCIENTIFIC SPECIAL SERVICES CHANNEL

By Dom Mallozzi N1DM

Introduction

Much is being written about the "new era" that the upcoming AMSAT Phase III spacecraft will bring to our hobby. One of the new "concepts" is channelization of a small portion of the downlink to provide for certain protected services. This and other new ideas were presented by WA2LQQ in his excellent article which appeared in the June 1979 AMSAT Newsletter. One of the "protected" services discussed was scientific experimentation. This would be carried out on the Scientific Special Services Channel (SSSC) designated L1 in WA2LQQ's bandplan.

The SSSC will be available whenever the satellite is open for use to any amateur or non-commercial group (with a ham sponsor) on a scheduled basis, to perform serious scientific experiments. The experiments should require a satellite path for proper analysis (satellite assisted ELT location, mobile long distance EKG transmission, propagation abnormalities on satellite communication paths, etc.).

The SSSC and Its Use

The SSSC is a 4kHz wide channel centered approximately 17 kHz higher in frequency with respect to the lower frequency beacon. The channel (and the rest of the transponder) is linear, that is it will repeat any signal, no matter what the mode, that appears on its uplink. The channel's 4kHz bandwidth is not a restriction; by advanced scheduling, use of the SSSC with adjacent channels (or even the whole passband) is possible if necessary. The experimenter should have a transmitter that can vary its frequency sufficently to keep the downlink centered in the channel. Experiments requiring continuous carrier power modes (i.e., AØ, FØ, F1, etc.) should be of a short duration (less than 60 seconds). Experimenters should use continuous carrier modes only when that type of mode is necessary to the purpose of the experiment.

Scheduling

Because of the nature of scientific experiments, scheduling of the SSSC will be different from the other SSSCs. The flowchart shown in Figure 1 shows the basic scheduling system. The system is based on three primary coordinators and many local coordinators. The flowchart is self-explanatory. A small notation is that on certain orbits that have a perigee "visible" only in Oceania, the Oceania SSSC Coordinator will be able to schedule those portions of the specified orbits without consulting the SSSC Coordinator. In all other cases the SSSC coordinator will give final assignment of timeslots for experiments. AMSAT through its SSSC coordinator reserves the rights for the scheduling of this channel.

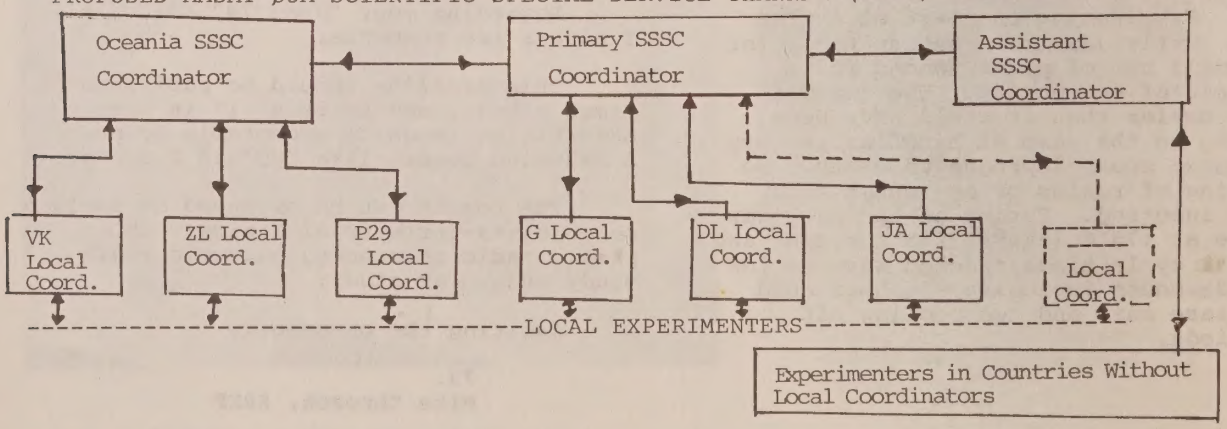
Conclusions

The Amateur community has continually contributed to the advancement of science and technology. AMSAT believes the SSSC will carry on this fine tradition. Furthermore, AMSAT hopes that this channel will be used by amateurs and scientists to its full potential, to improve the art and science of communication through "hands-on" experimentation.

The author wishes to thank the following who have contributed directly to this article: K1HTV, WA2LQQ, W2GFF, K2ZRO, W9KDR and WB1EYI. Any comments, questions or ideas on the SSSC are welcome. Please send them to: Dom Mallozzi N1DM, Scientific SSSC Coordinator, AMSAT, Box 27, Washington, DC 20044.

Figure 1

PROPOSED AMSAT-Ø3A SCIENTIFIC SPECIAL SERVICE CHANNEL (SSSC) COORDINATION TABLE



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